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National Eutrophication Survey, Corvallis, Oreg

Prepared for

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REPORT

ON

TIBER RESERVOIR

LIBERTY AND TOOLE COUNTIES

MONTANA

EPA REGION VIII

WORKING PAPER NO. 802

WITH THE COOPERATION OF THE

MONTANA DEPARTMENT OF HEALTH & ENVIRONMENTAL SCIENCES

AND THE

MONTANA NATIONAL GUARD

MAY, 1977

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

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CONTENTS

	Page
Foreword	ii
List of Montana Lakes and Reservoirs	iv
Lake and Drainage Area Map	v
Sections	
I. Conclusions	1
II. Lake and Drainage Basin Characteristics	4
III. Lake Water Quality Summary	5
IV. Nutrient Loadings	10
V. Literature Reviewed	15
VI. Appendices	16

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGEMENT

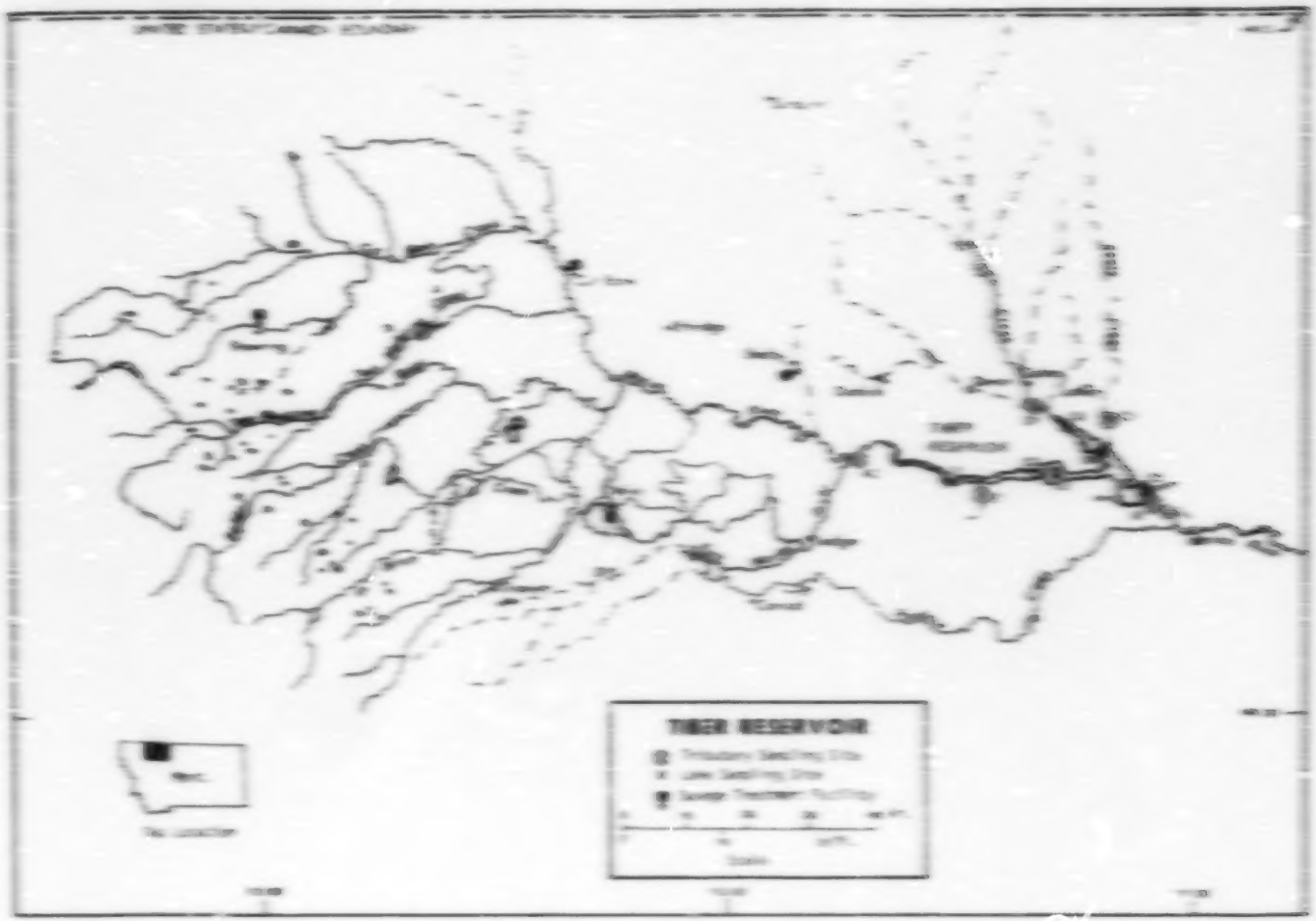
The staff of the National Eutrophication Survey (Office of Research & Development, U.S. Environmental Protection Agency) express sincere appreciation to the Montana Department of Health and Environmental Sciences for professional involvement, to the Montana National Guard for conducting the tributary sampling phase of the Survey, and to those Montana wastewater treatment plant operators who voluntarily provided effluent samples.

The staff of the Water Quality Bureau provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

Major General John J. Womack, the Adjutant General of Montana, and Project Officer Major William Yeager, who directed the volunteer efforts of the Montana National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY
STUDY LAKES AND RESERVOIRS
STATE OF MONTANA

LAKE NAME	COUNTY
Canyon Ferry	Broadwater, Lewis and Clark
Clark Canyon	Beaverhead
Flathead	Flathead, Lake
Georgetown	Deer Lodge, Granite
Hebgen	Gallatin
Koocanusa	Lincoln, MT; British Columbia, Can.
Mary Ronan	Lake
McDonald	Flathead
Nelson	Phillips
Seeley	Missoula
Swan	Lake
Tally	Flathead
Tiber	Liberty, Toole
Tongue River	Big Horn
Whitefish	Flathead
Yellowtail	Carbon, Bighorn, MT; Bighorn, WY


TIBER RESERVOIR

TIBER RESERVOIR

STORET NO. 3013

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Tiber Reservoir is meso-eutrophic. It ranked eighth in overall trophic quality when the 15 Montana lakes and reservoirs sampled in 1975 were compared using a combination of six water-quality parameters*. Six of the water bodies had less median total phosphorus, two had less and three had the same median dissolved orthophosphorus, 13 had less and one had the same median inorganic nitrogen, seven had less mean chlorophyll a, and 12 had greater mean Secchi disc transparency. Dissolved oxygen was not significantly depressed at depths as great as 42.7 meters.

Survey limnologists did not observe nuisance aquatic plants or surface concentrations of algae during their visits but noted that the water at times was quite turbid. Turbidity appears to be a major problem in this water body; it is noted in another study that the shores are steep, soft, and easily eroded, and because of the resulting turbidity, phytoplankton numbers are low (Stober, 1963).

* See Appendix A.

B. Rate-Limiting Nutrient:

The algal assay results indicate that Tiber Reservoir was limited by phosphorus at the time the sample was taken (09/09/75). The reservoir data indicate phosphorus limitation in July and September (with the exception of station 6 in September) and a combination of limiting nutrients in May. However, because of turbidity (Stober, op. cit.), primary productivity may be light-limited at times.

C. Nutrient Controllability:

1. Point sources--During the sampling year, the wastewater treatment facility at Shelby contributed 13.7% of the total phosphorus input to Tiber Reservoir. In addition, three other facilities of unknown significance at Valier, Cut Bank, and Browning were not included since they are beyond the 40-kilometer Survey limit* (see map, page v). Further investigation is needed to determine the significance of nutrient contributions from those sources; however, the nutrient export rates of the Marias River indicate minimal impact (see below).

The present phosphorus loading of 0.64 g/m^2/year is more than that proposed by Vollenweider (Vollenweider and Dillon, 1974) as an oligotrophic loading but less than his eutrophic loading (see page 14). Since the reservoir is phosphorus limited during much of the year, minimization of point-source loads could be considered as a means to maintain the present water quality, particularly if soil-conservation practices are initiated to reduce erosion in the drainage basin and the resulting

* See Working Paper No. 175, "...Survey Methods, 1973-1976".

turbidity in the reservoir.

2. Non-point sources--Non-point sources accounted for 86.3% of the total phosphorus load during the sampling year. The Marias River contributed 67.9% and Willow Creek contributed 10.3%. The ungaged minor tributaries and immediate drainage were estimated to have contributed 5.4%.

The phosphorus export rate of the Marias River was a low 2 kg/m^2 during the sampling year as was that of unimpacted Willow Creek. This indicates the distant point sources noted above probably were not significant contributors of phosphorus during the sampling year.

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 50.59 kilometers^2.
2. Mean depth: 15.3 meters.
3. Maximum depth: >42.7 meters.
4. Volume: 774.652 x 10^6 m^3.
5. Mean hydraulic retention time: 318 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Marias River	9,665.9	27.180
Willow Creek	2,177.2	0.383
Minor tributaries & immediate drainage -	867.2	0.607
Totals	12,710.3	28.170**

2. Outlet -

Marias River	12,760.9***	28.170

C. Precipitation****:

1. Year of sampling: 42.6 centimeters.
2. Mean annual: 26.4 centimeters.

† Table of metric conversions--Appendix B.
†† Aycock, 1976.
* For limits of accuracy, see Working Paper No 175, "...Survey Methods, 1973-1976".
** Sum of inflows adjusted to equal outflow.
*** Includes area of reservoir.
**** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Tiber Reservoir was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from one or more depths at six stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the last visit, two 18.9-liter depth-integrated samples were composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 1.5 meters at station 1, 25.9 meters at station 2, 18.6 meters at station 3, 19.8 meters at station 4, 42.7 meters at station 5, and 7.3 meters at station 6.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR TUNEY RESERVOIR
STUDY CODE 4333

	1ST SAMPLING : 9/30/75			2ND SAMPLING : 11/25/75			3RD SAMPLING : 2/ 9/76		
	STATION			STATION			STATION		
PARAMETER	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN	RANGE	MEAN	MEDIAN
TEMP (C)	5.4 - 13.3	9.4	9.6	6.7 - 21.1	15.2	17.7	4.1 - 13.7	11.4	12.7
DISS OXY (MG/L)	9.7 - 11.6	10.9	10.9	6.8 - 10.8	7.2	7.2	9.4 - 9.4	9.4	9.2
CNDCTVY (MICRO)	240. - 525.	384.	385.	250. - 495.	405.	407.	240. - 720.	480.	480.
PH (STAND UNITS)	8.3 - 8.5	8.3	8.3	7.9 - 8.4	8.1	8.2	7.9 - 8.3	8.3	8.3
TOT ALK (MG/L)	125. - 159.	134.	134.	115. - 155.	132.	132.	125. - 140.	140.	134.
TOT P (MG/L)	0.017 - 0.062	0.032	0.029	0.009 - 1.00	0.102	0.013	0.011 - 0.116	0.037	0.015
DIS P (MG/L)	0.007 - 0.029	0.017	0.017	0.002 - 0.011	0.004	0.002	0.002 - 0.009	0.003	0.002
NO2+NO3 (MG/L)	0.246 - 0.758	0.374	0.334	0.058 - 0.278	0.119	0.108	0.055 - 0.240	0.134	0.140
AMMONIA (MG/L)	0.025 - 0.092	0.044	0.035	0.008 - 0.078	0.044	0.040	0.015 - 0.070	0.029	0.025
KJEL N (MG/L)	0.286 - 0.782	0.356	0.318	0.208 - 0.406	0.261	0.258	0.208 - 0.488	0.259	0.248
INORG N (MG/L)	0.261 - 0.328	0.277	0.258	0.077 - 0.296	0.197	0.158	0.040 - 0.120	0.074	0.060
TOTAL N (MG/L)	0.246 - 0.782	0.337	0.296	0.208 - 0.571	0.467	0.415	0.208 - 0.728	0.468	0.478
CHLOPHYL A (UG/L)	5.0 - 5.9	3.1	3.0	0.7 - 4.	2.1	2.7	2.7 - 10.2	4.2	2.1
SECCHI (METERS)	0.3 - 1.0	0.5	0.4	0.3 - 0.3	2.4	2.5	0.2 - 2.1	1.0	0.9

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
05/30/75	1. Chroomonas sp.	417
	2. Ankistrodesmus sp.	179
	3. Synedra sp.	89
	4. Cryptomonas sp.	30
	5. Trachelomonas sp.	30
	Total	774
07/25/75	1. Nitzschia sp.	1,390
	2. Fragilaria sp.	348
	3. Chroomonas sp.	139
	4. Schroederia sp.	139
	5. Cryptomonas sp.	70
	Other genera	69
	Total	2,155
09/09/75	1. Synedra sp.	214
	2. Chroomonas sp.	143
	3. Oscillatoria sp.	107
	Total	464

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
05/30/75	1	1.6
	2	0.8
	3	1.0
	4	1.6
	5	1.2
	6	5.9
07/25/75	1	3.6
	2	0.7
	3	0.6
	4	4.1
	5	1.6
	6	1.9
09/09/75	1	4.6
	2	1.7
	3	1.6
	4	2.9
	5	1.7
	6	12.1

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. Stations 1, 2, and 3-

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.005	0.195	2.3
0.050 P	0.055	0.195	8.0
0.050 P + 1.0 N	0.055	1.195	8.4
1.0 N	0.005	1.195	0.2

b. Stations 4, 5, and 6 -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.005	0.190	0.3
0.050 P	0.055	0.190	8.4
0.050 P + 1.0 N	0.055	1.190	11.0
1.0 N	0.005	1.190	0.3

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential primary productivity of Tiber Reservoir was moderate at the time the samples were taken (09/09/75). Also, the increases in yields with the addition of phosphorus alone indicate the reservoir was phosphorus limited at that time. Note that increased yields did not result with the addition of nitrogen alone.

The reservoir data indicate phosphorus limitation in July and September, with the exception of station 6, and a combination of limiting nutrients is indicated in May. Following is a tabulation of the mean inorganic nitrogen/

orthophosphorus ratios at each sampling station and time with the indicated limiting nutrient in parentheses.

Station	05/06/75	07/25/75	09/09/75
1	8/1 (N)	39/1 (P)	33/1 (P)
2	12/1 (N)	44/1 (P)	75/1 (P)
3	15/1 (N?)	38/1 (P)	90/1 (P)
4	14/1 (P)	30/1 (P)	86/1 (P)
5	17/1 (P)	70/1 (P)	98/1 (P)
6	6/1 (N)	56/1 (P)	11/1 (N)

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Montana National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff month of June when two samples were collected. Sampling was begun in October, 1974, and was completed in September, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Montana District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads at station D-1, in kg/km^2/year, and multiplying by the ZZ area in km^2.

The operator of the Shelby wastewater treatment plant provided monthly effluent samples and corresponding flow data.

* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal* -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Shelby	3,200	stab. pond	2,561.0	Marias River

2. Known industrial - None

*Treatment plant questionnaire.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Marias River	21,810	67.9
Willow Creek	3,305	10.3
b. Minor tributaries & immediate drainage (non-point load) -	1,735	5.4
c. Known municipal STP's -		
Shelby	4,390	13.7
d. Septic tanks* -	<5	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	885	2.8
Total	32,125	100.0

2. Outputs -

Reservoir outlet - Marias River 13,855

3. Net annual P accumulation - 18,270 kg.

* Estimate based on 1 campground; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Marias River	1,510,080	92.1
Willow Creek	46,480	2.7
b. Minor tributaries & immediate drainage (non-point load) -	18,210	1.0
c. Known municipal STP's -		
Shelby	18,755	1.1
d. Septic tanks* -	70	<0.1
e. Known industrial - None	-	-
f. Direct precipitation** -	54,615	3.1
Total	1,749,110	100.0

2. Outputs -

Reservoir outlet - Marias River 740,560

3. Net annual N accumulation - 1,008,550 kg.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Marias River	9	167
Willow Creek	9	21

* Estimate based on 1 campground; see Working Paper No. 175.
** See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m²/yr	0.64	0.36	34.6	19.9

Vollenweider phosphorus loadings (g/m²/yr) based on mean depth and mean hydraulic retention time of Tiber Reservoir:

"Dangerous" (eutrophic loading)	0.80
"Permissible" (oligotrophic loading)	0.40

V. LITERATURE REVIEWED

Aycock, Gordon, 1976. Personal communication (reservoir morphometry). U.S. Bur. of Reclamation, Billings.

Stober, Quenton J., 1963. Some limnological effects of Tiber Reservoir on the Marias River, Montana. Proc. MT Acad. Sci. 23:111-137.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

[illegible] RANKED BY TWO YEL

RANK	LAKE CODE	LAKE NAME	[illegible]
1	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]

[illegible]

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107 x 10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

[illegible]

APPENDIX D

PHYSICAL and CHEMICAL DATA

25

27

29

STORET RETRIEVAL DATE [illegible]

[illegible]
46 25 38.0 111 17 20.0 3
TIBER RESERVOIR
30051 MONTANA
[illegible]

11EPALES [illegible]
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3+NH4- N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/30	15 10	0000	11.4	4.6	11	521	8.45	150	0.040	0.780	0.076	0.010
	15 12	0007	11.7	4.8		534	8.50	150	0.040	0.780	0.080	0.014
75/07/25	12 16	0000	24.4	7.6	115	477	8.35	147	0.040	0.400	0.086	0.002
	12 18	0005	24.4	7.8		478	8.38	146	0.040	0.400	0.070	0.002
	12 19	[illegible]	24.4	8.4		476	8.38	143	0.040	0.400	0.060	0.002
75/09/14	11 25	0000	13.3	[illegible]	12	510	8.40	145	0.025	0.400	0.020K	0.003
	11 25	[illegible]	13.3	6.2		512	8.50	146	0.030	0.420	0.025	0.006
	11 25	[illegible]	13.3	6.4		516	8.50	147	0.020K	0.400	0.025	0.003

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/30	15 10	0000	0.055	5.9	
	15 12	0007	0.054		
75/07/25	12 16	0000	[illegible]	1.9	
	12 18	0005			
	12 19	[illegible]	0.022		
75/09/14	11 25	0000	0.040	12.1	
	11 25	0005	0.056		
	11 25	[illegible]	0.044		

K VALUE KNOWN TO BE
LESS THAN INDICATED

APPENDIX E

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

[illegible]

DATE	TIME	DEPTH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12 15		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10 17		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10 44		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11 49		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	11 70		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	13 15		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	12 15		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10 11		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	08 15		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	09 11		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	14 11		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	10 11		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

35

STORET RETRIEVAL DATE 76/08/15

301301
48 2? 55.0 111 20 40.0 ?
WILLOW CREEK
30 T.S GALATA
TIBER RESERVOIR 040191
WILLOW CR ABOVE TIBER RES 1.7 M S GALATA
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3+NH4- N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/0?/1?	0? ??		0.010	1.450	1.530	0.015	0.415
75/0?/18	0? ??		0.100	1.450	1.090	0.115	0.350
75/0?/31	21 ??		0.005	1.400	0.105	0.010	0.070
75/0?/0?	0? ??		0.020	2.400	1.050	0.020	0.125